| **Grade** | **Big Idea** | **Essential Questions** | **Concepts** | **Competencies** | **Vocabulary** | **Standard** | **Eligible Content** |
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| **PreK-2** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. | Analyze the structures of organisms to explain how these structures help these organisms meet their needs. | Organism  Structures | 3.1.4.A  3.1.4.B  3.1.4.C  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.1.1.1  S4.B.1.1.2  S4.B.1.1.3  S4.B.1.1.4 |
| **PreK-2** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. | Make observations and describe the different parts of plants that help them survive, grow, reproduce, and respond to external inputs. | Observations  Reproduce  Survive  Grow  External  Input  Survival | 3.1.4.A  3.1.4.B  3.1.4.C  3.2.4.A  3.2.4.B  3.3.4.B  3.4.4.A  3.4.4.B  3.4.4.E  4.1.4.A  4.1.4.B  4.2.4.A  4.4.4.B  4.5.4.D  4.2.4.C | S4.A.3.1.1  S4.B.1.1.1  S4.B.1.1.2  S4.B.1.1.3  S4.B.1.1.4 |
| **PreK-2** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. | Generate questions to address a problem and design a model that replicates the function of an organism’s structure. | Model  Reproduction | 3.1.4.A  3.1.4.B  3.1.4.C  3.4.4.C  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.1.1.1  S4.B.1.1.2  S4.B.1.1.3  S4.B.1.1.4  S4.A.2.1.1 |
| **PreK-2** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms have unique and diverse life cycles that have similar features and predictable patterns. | Investigate the life cycles of organisms in order to compare similarities and differences among them including birth, growth, development, reproduction, and death. | Similarities  Differences  Growth | 3.1.4.A  3.1.4.B  3.1.4.C  3.2.4.A  3.3.4.A  3.3.4.B  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.1.1.5  S4.A.3.2.2  S4.A.3.2.3  S4.A.3.3.1 |
| **3-4** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | All living things reproduce, and some engage in behaviors that help their offspring to survive. | Obtain and share information to explain that patterns of behaviors between parents and offspring promote survival. | Behaviors  Parents  Offspring  Survival  Reproduce | 3.1.4.A  3.1.4.B  3.1.4.C  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.1.1.5 |
| **3-4** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | All living things reproduce, and some engage in behaviors that help their offspring to survive. | Discuss how some organisms can reproduce on their own, and some reproduce with two parents. | Reproduce  Parents  Offspring | 3.1.4.A  3.1.4.B  3.1.4.C  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.1.1.5 |
| **3-4** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms have basic needs. | Identify how a variety of organisms obtain food, water, and space while maintaining a stable internal environment. | Environment  Basic Needs  Stable  Internal Environment | 3.1.4.A  3.1.4.B  3.1.4.C  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.1.1.3 |
| **3-4** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms have basic needs. | Use observations and information to describe how some organisms make their own food (heterotrophs), while others obtain food (autotrophs). | Heterotroph  Autotroph | 3.1.4.A  3.1.4.B  3.1.4.C  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.1.1.3 |
| **3-4** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms have basic needs. | Investigate how animals use their senses to find food and water, and use their body parts to obtain food. | Senses | 3.1.4.A  3.1.4.B  3.1.4.C  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.1.1.1  S4.B.1.1.4 |
| **3-4** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms detect, process, and use information about the environment. | Provide examples of how animal body parts capture and convey different kinds of information, and how animals respond to these inputs with behaviors that help them grow and survive. |  | 3.1.4.A  3.1.4.B  3.1.4.C  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.1.1.1  S4.B.1.1.4 |
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| **5-6** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Unicellular organisms (microorganisms), like multicellular organisms, need food, water, a way to dispose of waste, and an environment in which they can live. | Investigate and generate evidence that unicellular and multicellular organisms survive by obtaining food and water, disposing of waste, and having an environment in which to live. | Unicellular  Multicellular | 3.1.8.A | S8.B.1.1.1  S8.B.1.1.2 |
| **5-6** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | In multicellular organisms, the body is a system of multiple interacting subsystems. | Construct models and representations of body systems to demonstrate how multiple interacting subsystems and structures work together to accomplish specific functions. | Systems  Subsystems | 3.1.8.A | S8.B.1.1.1  S8.B.1.1.3  S8.B.1.1.4 |
| **5-6** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms are affected by both genetic factors and local conditions. | Use evidence to support an explanation of how environmental and genetic factors affect the growth of organisms. | Genetic | 3.1.8.C  3.4.8.E | S8.B.2.1.1 |
| **5-6** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms are affected by both genetic factors and local conditions. | Investigate and present evidence that plants continue to grow throughout their life through the production of new plant matter via photosynthesis. | Photosynthesis | 3.1.8.A | S8.B.1.1.1 |
| **5-6** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. | Plan and conduct investigations to gather evidence for the relationship among specialized structures, specific behaviors, and the successful reproduction. | Sexual Reproduction  Asexual Reproduction | 3.1.8.A | S8.B.1.1.1  S8.B.1.1.2 |
| **5-6** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. | Plants reproduce in a variety of ways including using animals, wind, and water as a means of seed transfer and pollination. | Pollination  Transfer | 3.1.8.A | S8.B.1.1.1  S8.B.1.1.2 |
| **5-6** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Animals and plants alike generally need to take in air and water; animals must take in food, and plants need light and minerals. | Construct and communicate models of food webs that demonstrate the transfer of matter and energy among organisms within an ecosystem. | Food Webs  Ecosystem | 3.1.7.A8 | S8.B.3.1.1  S8.B.3.1.3 |
| **5-6** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Animals and plants alike generally need to take in air and water; animals must take in food, and plants need light and minerals. | Use models to communicate that plants obtain matter to grow chiefly from the air and water, and energy to grow from the sun. |  | 3.1.7.A8 | S8.B.3.1.1  S8.B.3.1.3 |
| **7-8** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Within cells, special structures are responsible for particular functions. | Construct an explanation for the function of specific parts of cells including: nucleus, chloroplasts, and mitochondria and the structure of the cell membrane and cell wall for maintaining a stable internal environment. | Nucleus  Chloroplast  Mitochondria  Cell Membrane  Cell Wall  Stable  Cell | 3.1.8.A | S8.B.1.1.1  S8.B.1.1.4 |
| **7-8** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | All living things are made up of cells and may consist of one single cell or many different numbers and types of cells. | Investigate and present evidence that the structure of cells in both unicellular and multicellular organisms is related to how cells function. | Multicellular  Unicellular  Organism | 3.1.8.A | S8.B.1.1.1  S8.B.1.1.4 |
| **7-8** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars from carbon dioxide and water through the process of photosynthesis, which also releases oxygen. | Develop an explanation for the role of photosynthesis in the cycling of matter and flow of energy on Earth. Plan and carry out investigations to determine the role of light in plant growth. | Algae  Phytoplankton | 3.1.7.A8 | S8.B.3.1.1  S8.B.3.1.3 |
| **7-8** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | In most animals and plants, oxygen reacts with carbon-containing molecules (sugars) to provide energy and produce carbon-dioxide. | Use models to explain the transfer of energy into, out of, and within ecosystems. | Model  Transfer of Energy  Carbon-Dioxide | 3.1.7.A8 | S8.B.3.1.1  S8.B.3.1.2 |
| **7-8** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Animals obtain food from eating plants or eating other animals. | Investigate how food provides animals with the materials they need for body repair and growth, and is digested by animals to release the energy they need to maintain body warmth and allow for motion. |  | 3.1.8.A | S8.B.1.1.1  S8.B.1.1.4 |
| **7-8** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Within individual organisms, food moves through a series of chemical reactions to support growth or to release energy. | Use evidence to support an explanation that matter is conserved when molecules from food react with oxygen in the environment and cycle repeatedly between living and non-living components of ecosystem. |  | 3.1.8.A  3.3.8.A  3.4.8.B  4.3.8.A  4.5.8.A | S8.B.3.1.1  S8.B.3.3.2  S8.B.3.3.3  S8.B.3.3.4 |
| **7-8** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms use sense receptors to responds to different inputs, resulting in immediate behaviors or memories. | Provide explanations of how sense receptors respond to stimuli by transmitting messages as signals that travel along the nerve cells to the brain to be processed for immediate behavior or stored as information. | Receptor | 3.1.8.A | S8.B.1.1.1 |
| **7-8** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Organisms use sense receptors to responds to different inputs, resulting in immediate behaviors or memories. | Communicate an explanation for how the storage of long-term memories requires changes in the structure and function of millions of interconnected nerve cells in the brain. |  | 3.1.8.A | S8.B.1.1.1 |
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| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. | Communicate information about how DNA sequences determine the structure and function of proteins. | DNA Sequence  Gene  Genetic Information  Protein | 3.1.B.A1  3.1.B.A2  3.1.B.A5  3.1.B.B1  3.1.B.B2  3.1.B.B3  3.1.B.B5  3.1.B.C2  3.1.C.B3  3.1.C.C2  4.1.4.A | BIO.B.1.2.2  BIO.B.2.2.1  BIO.2.2.2  BIO.A.1.2.1  BIO.A.4.1.3 |
| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. | Develop and use models to explain the hierarchical organization of interacting systems working together to provide specific functions within multicellular organisms. | Hierarchical Organization  Multicellular | 3.1.B.A1 3.1.B.A5 3.1.B.A6  3.1.B.C2  4.1.3.A  4.1.4.A | BIO.A.1.1.1  BIO.A.1.2.2 |
| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Feedback mechanisms maintain a living system’s internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. | Use modeling to explain the function of positive and negative feedback mechanisms in maintaining homeostasis that is essential for organisms. | Homeostasis | 3.1.B.A8  3.1.B.A5  3.1.B.A2  3.1.B.A4  3.1.B.A7  3.2.C.A1  3.2.B.B6  4.5.4.D  4.4.2.C | BIO.A.4.2.1  BIO.A.4.1.1  BIO.A.4.1.2 |
| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow. The organism begins as a single cell that divides successively to produce many cells, with each parent cell passing identical genetic material to both daughter cells. | Use a model to explain how mitotic cell division results in daughter cells with identical patterns of genetic materials essential for growth and repair of multicellular organisms. | Mitosis  Genetic Material | 3.1.B.A.4 3.1.B.A5  3.1.B.B2  3.1.B.B3  3.1.B.B5  3.1.B.C2  3.1.C.C2 | BIO.B.1.1.1 |
| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | As successive subdivisions of an embryo’s cells occur, programmed genetic instructions and small differences in their immediate environments activate or inactivate different genes, which cause the cells to develop differently—a process called differentiation. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. | Use a model to describe the role of cellular division and differentiation to produce and maintain complex organisms composed of organ systems and tissue subsystems that work together to meet the needs of the entire organism. | Organ Systems  Cellular Division | 3.1.B.A1 3.1.B.A5 3.1.B.A6 | BIO.A.1.2.2 |
| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | In sexual reproduction, a specialized type of cell division called meiosis occurs that results in the production of sex cells, such as gametes in animals (sperm and eggs), which contain only one member from each chromosome pair in the parent cell. | Communicate information about the role of the structure of DNA and the mechanisms in meiosis for transmitting genetic information from parents to offspring. | DNA  Meiosis  Gametes  Chromosomes | 3.1.B.A4  3.1.B.A5  3.1.B.B1  3.1.B.B2  3.1.B.B3 3.1.B.B5 3.1.B.C2  3.1.C.C2 | BIO.B.1.2.1  BIO.B.1.1.2 |
| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars and released oxygen. The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules. | Construct a model to support explanations of the process of photosynthesis by which light energy is converted to stored energy. | Carbon  Hydrogen  Oxygen  Hydrocarbon  Carbon-Based  Molecule  Hydrocarbon Backbones | 3.1.B.A2  3.1.B.A5  3.1.C.A1  3.1.C.A2  4.1.10.C | BIO.A.3.1.1  BIO.A.3.2.1  BIO.A.3.2.2 |
| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. | Construct an explanation of how sugar molecules that contain carbon, hydrogen, and oxygen are combined with other elements to form amino acids and other large carbon-based molecules. | Energy Flow  Amino Acid | 3.1.B.A2  3.1.B.A7  3.1.B.A8  3.1.C.A2  3.1.C.A7  3.2.C.A2 | BIO.A.2.2.1  BIO.A.2.2.2  BIO.A.2.2.3 |
| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. | Use a model to explain cellular respiration as a chemical process whereby the bonds of food molecules and oxygen molecules are broken and bonds in new compounds are formed that result in a net transfer of energy. | Model  Chemical Process  Compounds  Transfer of Energy | 3.1.B.A2  3.1.B.A5  3.1.B.A7  3.1.C.A1  4.1.10.C | BIO.A.2.3.1  BIO.A.2.3.2  BIO.A.3.1.1  BIO.A.3.2.1 |
| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Anaerobic (without oxygen) cellular respiration follows a different and less efficient chemical pathway to provide energy in cells. | Evaluate data to compare the energy efficiency of aerobic and anaerobic respiration within organisms. | Anaerobic  Respiration  Aerobic Respiration | 3.1.B.A2  3.1.B.A5  3.1.C.A1  4.1.10.C | BIO.A.3.2.1 |
| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Matter and energy are conserved in each change. This is true of all biological systems, from individual cells to ecosystems. | Evaluate data to compare the energy efficiency of aerobic and anaerobic respiration within organisms. | Aerobic  Anaerobic  Biological Systems | 3.1.B.A2  3.1.B.A5  3.1.C.A1  4.1.10.C | BIO.A.3.2.1 |
| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | In complex animals, the brain is divided into several distinct regions and circuits, each of which primarily serves dedicated functions, such as visual perception, auditory perception, interpretation of perceptual information, guidance of motor movement, and decision making about actions to take in the event of certain inputs. | Use evidence to support explanations for the relationship between a region of the brain and the primary function of that region. | Complex Animals  Visual Perception  Perceptual Information  Motor Movement | 3.1.B.A5  3.1.B.A6  3.1.B.A1 | BIO.A.1.2.2 |
| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | The integrated functioning of all parts of the brain is important for successful interpretation of inputs and generation of behaviors in response to them. | Gather and communicate information to explain the integrated functioning for all parts of the brain for successful interpretation of inputs and generation of behaviors. | Input | 3.1.B.A5  3.1.B.A6  3.1.B.A1 | BIO.A.1.2.2 |
| **9-12** | All organisms are made of cells and can be characterized by common aspects of their structure and functioning. | How do organisms live, grow, respond to their environment, and reproduce? | Some circuits give rise to emotions and memories that motivate organisms to seek rewards, avoid punishments, develop fears, or form attachments to members of their own species and, in some cases, to individuals of other species (e.g., mixed herds of mammals, mixed flocks of birds). | Analyze and interpret data to identify patterns of behavior that motivate organisms to seek rewards, avoid punishments, develop fears, or form attachments to members of their own species and, in some cases, to individuals of other species. | Rewards  Punishment | 3.1.B.A5  3.1.B.A6  3.1.B.A1 | BIO.A.1.2.2 |
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| **PreK-2** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Animals can move around, but plants cannot, and they often depend on animals for pollination or seed dispersal. | Describe different modes of seed dispersal. Investigate effectiveness of different types of seed dispersal. | Seed Dispersal | 3.1.4.A  3.1.4.B  3.1.4.C  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.1.1.1  S4.B.1.1.5  S4.B.2.1.1 |
| **PreK-2** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Different plants survive better in different settings because they have varied needs for water, minerals, and sunlight. | Plan and carry out investigations to test whether plants from different settings have different needs for water, sunlight, and type of soil. | Minerals  Water  Sunlight  Soil | 3.1.4.A  3.1.4.B  3.1.4.C  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.2.1.1  S4.B.2.1.2 |
| **PreK-2** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Organisms obtain the materials they need to grow and survive from their environment. | Obtain, evaluate, and communicate information that in any particular environment, some kinds of organisms survive well and some do not. | Survive  Environment | 3.1.4.A  3.1.4.C  4.5.4.D  4.2.4.C | S4.B.2.1.1  S4.B.2.1.2 |
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| **3-4** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Animals (consumers) depend on their surroundings to get what they need, including food, water, shelter, and a stable temperature. | Construct a representation in which plants and animals depend on their environment and each other to meet their needs. | Representation  Consumer  Stable | 3.1.4.A  3.1.4.C  3.2.4.A  3.2.4.B  3.3.4.B  3.4.4.A  3.4.4.B  3.4.4.E  4.1.4.A  4.1.4.B  4.1.4.C  4.2.4.A  4.2.4.B  4.2.4.C  4.4.4.B  4.5.4.D | S4.A.3.1.2  S4.A.3.1.3  S4.B.2.1.1  S4.B.3.1.1 |
| **3-4** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Plants (producers), depend on air, water, minerals (in the soil), and light to grow. | Construct a representation in which plants and animals depend on their environment and each other to meet their needs. | Producer | 3.1.4.A  3.1.4.B  3.1.4.C  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.1.1.3  S4.B.1.1.5 |
| **3-4** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Some organisms, (decomposers), break down dead or decaying material to obtain energy. | Construct a representation in which plants and animals depend on their environment and each other to meet their needs. | Decomposer  Energy  Decay | 3.1.4.A  3.1.4.B  3.1.4.C  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.1.1.3  S4.B.1.1.5 |
| **3-4** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | The places where plants and animals live often change, sometimes slowly and sometimes rapidly. | Observe an organism in which a model habitat is changed in some way, such as light, or temperature. | Interaction | 3.1.4.A  3.1.4.C  3.1.4.E  3.2.4.A  3.2.4.B  3.4.4.A  3.4.4.B  3.4.4.C  3.4.4.D  3.4.4.E  4.5.4.C  4.5.4.D  4.2.4.C | S4.B.2.1.2  S4.A.1.3.1  S4.A.1.3.3  S4.A.2.1.2  S4.A.2.1.3  S4.A.2.2.1 |
| **3-4** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | The places where plants and animals live often change, sometimes slowly and sometimes rapidly. | Use data about the characteristics of organisms and habitats to design an artificial habitat in which organisms can survive. | Characteristic  Habitat | 3.1.4.A  3.4.4.C  4.1.4.A  4.5.4.A  4.5.4.C | S4.A.2.1.4  S4.B.3.2.1 |
| **3-4** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Changes in an organism's habitat can be beneficial or harmful to the organism. | Use evidence to argue that when the environment changes in ways that affect a place’s physical characteristics, organisms may survive, move to new locations, or die. | Physical Characteristic | 3.1.4.A  3.1.4.B  3.1.4.C  3.1.4.E  3.2.4.A  3.2.4.B  3.3.4.A  3.3.4.B  3.4.4.B  3.4.4.D  3.4.4.E  4.1.4.A  4.1.4.E  4.4.4.A  4.4.4.D  4.5.4.A  4.5.4.C | S4.B.3.2.1  S4.B.3.2.2  S4.B.3.2.3  S4.A.1.1.1  S4.A.1.3.2  S4.A.1.3.4  S.4.A.3.2.1  S4.A.3.3.2 |
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| **5-6** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. | Ask researchable questions about the ways organisms obtain matter and energy across multiple and varied ecosystems. | Researchable  Species  Web of Life | 3.1.6.A2 | S8.B.3.1.1 |
| **5-6** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. | Use models to trace the cycling of particles of matter between the air and soil and among plants, animals, and microbes. | Matter  Cycles  Microbes | 3.1.6.A2 | S8.B.3.1.1  S8.B.3.1.2 |
| **5-6** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Matter cycles between the air and soil and among plants, animals, and microbes as these organisms live and die. | Use models to describe how decomposition eventually restores (recycles) some materials back to the soil for plants to use. | Decomposition  Microbes | 3.1.6.A2 | S8.B.3.1.1  S8.B.3.1.2  S8.B.3.1.3 |
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| **7-8** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Organisms, and populations of organisms, are dependent on their environmental interactions with other living things and nonliving factors. | Cite examples of how organisms and populations of organisms depend on their environmental interactions. | Interaction  Dependent | 3.1.8.A  3.4.8.A  3.4.8.B  4.2.8.C  4.4.8.A  4.5.8.A  4.5.8.C  4.5.8.D | S8.B.3.2.1  S8.B.3.2.2  S8.B.3.2.3  S8.A.1.1.1  S8.A.1.1.2  S8.A.1.1.3  S8.A.1.1.4  S8.A.1.2.2 |
| **7-8** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Growth of organisms and population increases are limited by access to resources. | Use a model to demonstrate the effect of resource availability on organisms and populations of organisms in an ecosystem. | Resource Availability | 3.1.8.A  3.3.8.A  3.4.8.B  4.3.8.A  4.4.8.A  4.5.8.A  4.5.8.C  4.5.8.D | S8.B.3.3.1  S8.A.1.2.4 |
| **7-8** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. | Construct explanations to describe competitive, predatory, and mutually beneficial interactions as patterns across various ecosystems. | Predatory  Mutually Beneficial  Competitive | 3.1.7.A2 | S.8.3.1.3 |
| **7-8** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. | Investigate the cycling of matter among living parts of ecosystems to explain the flow of energy and conservation of matter. | Conservation of Matter  Flow of Energy  Producer  Consumer  Decomposer | 3.1.7.A.2 | S8.B.3.1.1 |
| **7-8** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Food webs are models that demonstrate how matter and energy is transferred between producers, consumers, and decomposers as the three groups interact within an ecosystem. | Use models to explain the transfer of energy into, out of, and within ecosystems. | Food Web  Model  Transfer of Energy | 3.1.7.A2 | S8.B.3.1.1 |
| **7-8** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Organisms obtain gases, water, and minerals from the environment, and release waste matter (gas, liquid, or solid) back into the environment. | Design and construct a model to describe the interactions of systems within an ecosystem in terms of the flow of energy, cycling of matter, and the conditions for a healthy ecosystem. | Flow of Energy  Cycling of Matter  Gases  Minerals  Waste Matter | 3.1.7.A2 | S8.B.3.1.1 |
| **7-8** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Ecosystems are dynamic in nature; their characteristics can vary over time. | Use evidence to support arguments that changing any physical or biological component of an ecosystem may result in shifts in the populations of species in the ecosystem. | Ecosystem | 3.1.8.A  3.4.8.A  4.2.8.C | S8.B.3.2.1  S8.B.3.2.3 |
| **7-8** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Biodiversity describes the variety of species found in Earth’s terrestrial and oceanic ecosystems. | Use models to explain why the completeness or integrity of an ecosystem’s biodiversity is often used as a measure of its health. | Biodiversity  Terrestrial  Oceanic | 3.1.8.A  3.4.8.A  4.2.8.C  3.1.8.C1 | S8.B.3.2.2 |
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| **9-12** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. | Evaluate data to explain resource availability and other environmental factors that affect carrying capacity of ecosystems. | Carrying Capacity | 4.1.4.A  4.1.10.A  4.1.12.A  4.1.7.E  4.1.10.E  4.1.4.E  4.2.10.C  4.5.3.D  4.5.5.D  4.5.6.D  4.5.10.D  4.2.10.A  4.2.7.A  4.2.8.A  4.2.10.B  4.4.6.A  4.4.6.B  4.4.3.C  4.4.5.C  4.5.7.B  4.5.7.C | BIO.B.4.1 BIO.B.4.2 |
| **9-12** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. | Evaluate data to explain resource availability and other environmental factors that affect carrying capacity of ecosystems. | Resource Availability  Environmental Factors  Carrying Capacity | 4.1.4.A  4.1.10.A  4.1.12.A  4.1.7.E  4.1.10.E  4.1.4.E  4.2.10.C  4.5.3.D  4.5.5.D  4.5.6.D  4.5.10.D  4.2.10.A  4.2.7.A  4.2.8.A  4.2.10.B  4.4.6.A  4.4.6.B  4.4.3.C  4.4.5.C  4.5.7.B  4.5.7.C | BIO.B.4.2.5 |
| **9-12** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. | Plan and carry out investigations to make mathematical comparisons of the populations and biodiversities of two similar ecosystems at different scales. | Biodiversities  Mathematical Comparisons | 4.1.4.A  4.1.10.A  4.1.12.A  4.1.7.E  4.1.10.E  4.1.4.E  4.2.10.C  4.5.3.D  4.5.5.D  4.5.6.D  4.5.10.D  4.2.10.A  4.2.7.A  4.2.8.A  4.2.10.B  4.4.6.A  4.4.6.B  4.4.3.C  4.4.5.C  4.5.7.B  4.5.7.C | BIO.B.4.2.5 |
| **9-12** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. | Use data to develop mathematical models to describe the flow of matter and energy between organisms and the ecosystem. | Mathematical Model  Flow of Matter  Flow of Energy  Life Functions | 4.1.4.C  4.1.7.C  4.1.10.C  4.1.12.C  4.1.3.C  4.1.5.C  4.1.5.A | BIO.B.4.2.1 |
| **9-12** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes. | Use data to develop mathematical models to describe the flow of matter and energy between organisms and the ecosystem. | Mathematical Model  Flow of Matter  Flow of Energy | 4.1.4.C  4.1.7.C  4.1.10.C  4.1.12.C  4.1.3.C  4.1.5.C  4.1.5.A | BIO.B.4.2.1 |
| **9-12** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. | Use data to develop mathematical models to describe the flow of matter and energy between organisms and the ecosystem. | Mathematical Model  Flow of Matter  Flow of Energy  Cellular Respiration | 4.1.4.C  4.1.7.C  4.1.10.C  4.1.12.C  4.1.3.C  4.1.5.C  4.1.5.A | BIO.B.4.2.1 |
| **9-12** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. | Use data to develop mathematical models to describe the flow of matter and energy between organisms and the ecosystem. | Mathematical Model  Flow of Matter  Flow of Energy | 4.1.4.C  4.1.7.C  4.1.10.C  4.1.12.C  4.1.3.C  4.1.5.C  4.1.5.A | BIO.B.4.2.1 |
| **9-12** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged between the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. | Communicate descriptions of the roles of photosynthesis and cellular respiration in the carbon cycle specific to the carbon exchanges among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological processes. | Chemical Processes  Physical Processes  Geological Processes  Biological Processes  Geosphere | 4.1.4.A  4.1.7.A  4.1.10.A  4.1.7.C  4.4.6.A  4.5.3.D  4.1.3.A  4.1.4.B  4.2.10.A  4.1.4.C  4.4.5.C  4.4.3.C  4.1.10.C  4.1.12.C  4.1.3.C  4.1.5.C  4.1.5.A  4.5.6.D | BIO.B.4.1.1  BIO.B.4.1.2  BIO.B.4.2.1  BIO.B.4.2.2 |
| **9-12** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. | Provide evidence to support explanations of how elements and energy are conserved as they cycle through ecosystems and how organisms compete for matter and energy. | Elements | 4.1.4.A  4.1.7.A  4.1.10.A  4.1.7.C  4.4.6.A  4.5.3.D  4.1.3.A  4.1.4.B  4.2.10.A  4.1.4.C  4.4.5.C  4.4.3.C  4.1.10.C  4.1.12.C  4.1.3.C  4.1.5.C  4.1.5.A  4.5.6.D | BIO.B.4.1.1  BIO.B.4.1.2  BIO.B.4.2.1  BIO.B.4.2.2 |
| **9-12** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Competition among species is ultimately competition for the matter and energy needed for life. | Provide evidence to support explanations of how elements and energy are conserved as they cycle through ecosystems and how organisms compete for matter and energy. | Competition | 4.1.4.A  4.1.7.A  4.1.10.A  4.1.7.C  4.4.6.A  4.5.3.D  4.1.3.A  4.1.4.B  4.2.10.A  4.1.4.C  4.4.5.C  4.4.3.C  4.1.10.C  4.1.12.C  4.1.3.C  4.1.5.C  4.1.5.A  4.5.6.D | BIO.B.4.1.1  BIO.B.4.1.2  BIO.B.4.2.1  BIO.B.4.2.2 |
| **9-12** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability. | Construct and use a model to communicate how complex sets of interactions in ecosystems maintain relatively consistent numbers and types of organisms for long periods of time when conditions are stable. | Model | 4.1.4.A  4.1.10.A  4.1.12.A  4.1.7.E  4.1.10.E  4.1.4.E  4.2.10.C  4.5.3.D  4.5.5.D  4.5.6.D  4.5.10.D  4.2.10.A  4.2.7.A  4.2.8.A  4.2.10.B  4.4.6.A  4.4.6.B  4.4.3.C  4.4.5.C  4.5.7.B  4.5.7.C | BIO.B.4.2.5 |
| **9-12** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. | Construct and use a model to communicate how complex sets of interactions in ecosystems maintain relatively consistent numbers and types of organisms for long periods of time when conditions are stable. |  | 4.1.4.A  4.1.10.A  4.1.12.A  4.1.7.E  4.1.10.E  4.1.4.E  4.2.10.C  4.5.3.D  4.5.5.D  4.5.6.D  4.5.10.D  4.2.10.A  4.2.7.A  4.2.8.A  4.2.10.B  4.4.6.A  4.4.6.B  4.4.3.C  4.4.5.C  4.5.7.B  4.5.7.C | BIO.B.4.2.5 |
| **9-12** | Organisms grow, reproduce, and perpetuate their species by obtaining necessary resources through interdependent relationships with other organisms and the physical environment. | How and why do organisms interact with their environment and what are the effects of these interactions? | If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. | Construct arguments from evidence about the effects of natural biological or physical disturbances in terms of the time needed to reestablish a stable ecosystem and how the new system differs from the original system. | Biological Disturbance  Physical Disturbance  Resilient | 4.1.10.A  4.1.10.B  4.1.12.A  4.1.4.A  4.1.12.C  4.1.4.E  4.1.7.E  4.1.10.E  4.5.10.D  4.2.8.A  4.2.10.A  4.2.12.A  4.2.10.B  4.2.12.B  4.2.10.C  4.2.12.C  4.3.12.A  4.3.10.B  4.5.10.B  4.5.12.B  4.5.4.C  4.5.7.C | BIO.B.4.2.4 |
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| **PreK-2** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | Individuals of the same species are recognizable as similar, but can also vary in many ways. | Obtain and communicate information about different versions of the same traits within a species. | Similar  Vary  Traits  Species | 3.1.4.B  3.1.4.C | S4.B.2.2.1 |
| **PreK-2** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | The environment may affect the traits that an organism develops. | Use evidence to describe patterns of variation in a trait across individuals of the same kind of organism. | Patterns  Variation  Organism  Trait | 3.1.4.A  3.1.4.C  4.5.4.D  4.2.4.C | S4.B.2.1.2 |
| **PreK-2** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | Offspring acquire a mix of traits from their biological parents. | Provide evidence that offspring can inherit different information from their parents. | Offspring  Biological Parents  Inherit  Evidence  Characteristics | 3.1.4.B  3.1.4.C | S4.B.2.2.1 |
| **3-4** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | Many characteristics involve both inherited traits and environmental factors. | Use evidence to compare characteristics inherited from parents, characteristics caused by the environment, and those resulting from both. | Characteristics  Inherited  Traits  Environmental Factors  Siblings  Generation | 3.1.4.A  3.1.4.B  3.1.4.C  4.5.4.D  4.2.4.C | S4.B.2.1.1  S4.B.2.2.1 |
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| **7-8** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | Genetic contribution from each parent through sexual reproduction results in variation in offspring, and asexual reproduction results in offspring with identical genetic information. | Use models to demonstrate genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. | Genes  Chromosomes  Variants  Asexual Reproduction  Sexual Reproduction | 3.1.8.C | S8.B.2.2.2 |
| **7-8** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | Genetic contribution from each parent through sexual reproduction results in variation in offspring and asexual reproduction results in offspring with identical genetic information. | Use models to demonstrate that sexual reproduction provides for transmission of genetic information to offspring through egg and sperm cells. | Egg Cells  Sperm Cells | 3.1.8.A  3.1.8.C  3.4.8.B  4.4.8.A  4.5.8.A  4.5.8.C  4.5.8.D | S8.B.2.2.2  S8.A.1.2.3 |
| **7-8** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | Genetic contribution from each parent through sexual reproduction results in variation in offspring and asexual reproduction results in offspring with identical genetic information. | Describe how variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited or (more rarely) from mutations. | Mutations | 3.1.8.C | S8.B.2.2.1 |
| **7-8** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. | Provide an explanation for the relationship among changes (mutations) to genes, changes to the formation of proteins, and the effect on the structure and function of the organism and thereby traits. | Proteins | 3.1.8.C  3.4.8.E | S8.B.2.1.3 |
| **5-6** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. | Use models to demonstrate that offspring acquire genes from each parent. | Genes | 3.1.8.C  3.4.8.E | S8.B.2.1.1  S8.B.2.2.2 |
| **7-8** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. | Describe how some genetic mutations are beneficial, others harmful, and some neutral to the organism. | Genetic Mutation | 3.1.8.C  3.4.8.E | S8.B.2.1.3 |
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| **9-12** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species’ characteristics are carried in DNA. | Ask questions and obtain information about the role of patterns of gene sequences in DNA molecules and subsequent inheritance of traits. | DNA | 3.1.10.B3 3.10.B.B3 3.10.C.B3 |  |
| **9-12** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | Each chromosome consists of a single very long DNA molecule, and each gene on the chromosome is a particular segment of that DNA. The instructions for forming species’ characteristics are carried in DNA. | Ask questions and obtain information about the role of patterns of gene sequences in DNA molecules and subsequent inheritance of traits. | DNA Molecules  Inheritance  Traits | 3.1.B.B1  3.1.B.B5  3.1.B.B2  3.1.B.B3  3.1.C.C2 | BIO.B.1.2.2 |
| **9-12** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | All cells in an organism have the same genetic content, but the genes used (expressed) by the cell may be regulated in different ways. Not all DNA codes for a protein; some segments of DNA are involved in regulatory or structural functions, and some have no as of yet known function. | Construct an explanation for how cell differentiation is the result of activation or inactivation of specific genes as well as small differences in the immediate environment of the cells. | DNA Codes  Genetic Content  Regulatory Functions  Structural Functions  Activation  Inactivation | 3.1.B.B1  3.1.B.B3  3.1.B.B5  3.1.C.B3  3.1.C.C2 | BIO.B.2.2.1 |
| **9-12** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | The information passed from parents to offspring is coded in the DNA molecules that form the chromosomes. | Communicate information that inheritable genetic variations may result from (1) genetic combinations in haploid sex cells, (2) errors occurring during replication, (3) crossover between homologous chromosomes during meiosis, and (4) environmental factors. | Haploid Sex Cells  Homologous Chromosomes  Meiosis | 3.1.B.B1  3.1.B.B2  3.1.B.B3  3.1.C.C2 | BIO.B.2.1.2 |
| **9-12** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | In sexual reproduction, chromosomes can sometimes swap sections during the process of meiosis (cell division), thereby creating new genetic combinations and thus more genetic variation. | Communicate information that inheritable genetic variations may result from (1) genetic combinations in haploid sex cells, (2) errors occurring during replication, (3) crossover between homologous chromosomes during meiosis, and (4) environmental factors. | Haploid Sex Cells  Homologous Chromosomes  Meiosis | 3.1.B.B1  3.1.B.B2  3.1.B.B3  3.1.C.C2 | BIO.B.2.1.2 |
| **9-12** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | Although DNA replication is tightly regulated and remarkably accurate, errors do occur and result in mutations, which are also a source of genetic variation. | Communicate information that inheritable genetic variations may result from (1) genetic combinations in haploid sex cells, (2) errors occurring during replication, (3) crossover between homologous chromosomes during meiosis, and (4) environmental factors. | Haploid Sex Cells  Homologous Chromosomes  Meiosis  Genetic Variation | 3.1.B.B1  3.1.B.B2  3.1.B.B3  3.1.B.C2  3.1.C.B3  3.1.C.C2 | BIO.B.2.1.2  BIO.B.2.3.1 |
| **9-12** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | Environmental factors can also cause mutations in genes, and viable mutations are inherited. | Communicate information that inheritable genetic variations may result from (1) genetic combinations in haploid sex cells, (2) errors occurring during replication, (3) crossover between homologous chromosomes during meiosis, and (4) environmental factors. | Haploid Sex Cells  Homologous Chromosomes  Meiosis  Mutation | 3.1.B.B1  3.1.B.B2  3.1.B.B3  3.1.B.B4  3.1.C.C2  4.4.7.A  4.4.10.A  4.4.12.A  4.4.7.B  4.4.10.B  4.4.12.B | BIO.B.2.1.2  BIO.B.2.4.1 |
| **9-12** | Heredity refers to specific mechanisms by which characteristics or traits are passed from one generation to the next via genes, and explains why offspring resemble, but are not identical to, their parents. | How are the characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics? | Environmental factors also affect expression of traits, and hence affect the probability of occurrences of traits in a population. | Use probability to explain the variation and distribution of expressed traits in a population. | Probability | 3.1.B.B5 | BIO.B.2.1.1 |
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| **PreK-2** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Living things can survive only where their needs are met. | Construct an explanation about why living things can only survive where their needs are met. | Microorganisms  Biodiversity  Survive  Needs  Organism | 3.1.4.A  3.1.4.C  4.5.4.D  4.2.4.C | S4.B.2.1.2 |
| **PreK-2** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | There are many different kinds of living things in any area, and they exist in different places on land and in water. | Observe and compare the many kinds of living things that are found in different areas. | Exist  Living Things | 3.1.4.A  3.1.4.C  4.5.4.D  4.2.4.C | S4.B.2.1.1  S4.B.2.1.2 |
| **PreK-2** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Scientists identify and classify all living things. | Use observations and information to classify living things. | Observation  Information  Classify  Identify | 3.1.4.A  3.1.4.B  3.1.4.C  4.1.4.A  4.5.4.D  4.2.4.C | S4.B.1.1.2 |
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| **3-4** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Fossils provide evidence about the types of organisms (both visible and microscopic) that lived long ago and also about the nature of their environments. | Use evidence to construct an explanation that some rocks and minerals record the remains of organisms. | Fossils  Microscopic | 3.1.4.A  3.1.4.C  4.5.4.D  4.2.4.C | S4.B.2.1.2 |
| **3-4** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Fossils provide evidence about the types of organisms (both visible and microscopic) that lived long ago and also about the nature of their environments. | Obtain and communicate information that some organisms that once lived on earth are no longer found anywhere, although other organisms now may resemble them. | Organism  Visible Organism  Microscopic Organism | 3.1.4.A  3.1.4.C  4.5.4.D  4.2.4.C | S4.B.2.1.2 |
| **3-4** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Fossils can be compared with one another and to living organisms according to their similarities and differences. | Use evidence from fossil records to construct an explanation of the relationship between types of organisms living today and types of organisms that lived in the past. | Fossil Record  Explanation | 3.1.4.A  3.1.4.C  4.5.4.D  4.2.4.C | S4.B.2.1.2 |
| **3-4** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Fossils can be compared with one another and to living organisms according to their similarities and differences. | Use evidence to construct explanations for how environments today may be different from past environments in which fossilized organisms once lived. | Fossil | 3.1.4.A  3.1.4.C  4.5.4.D  4.2.4.C | S4.B.2.1.2 |
| **3-4** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates, and reproducing. | Use evidence to explain how some characteristics that vary among individuals of the same kind of organism can provide advantages to survive, find mates, and reproduce. | Survive  Reproduce | 3.1.4.A  3.1.4.C  4.5.4.D  4.2.4.C | S4.B.2.1.2 |
| **3-4** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Humans, like all other organisms, obtain living and nonliving resources from their environments. | Use evidence to demonstrate how humans, like all other organisms, obtain living and non-living resources from their environment. | Living  Non-Living | 3.1.4.A  3.1.4.C  3.1.4.E  3.2.4.A  3.2.4.B  3.3.4.B  3.4.4.A  3.4.4.B  3.4.4.E  3.4.4.D  4.1.4.A  4.1.4.B  4.1.4.E  4.2.4.A  4.3.4.A  4.4.4.A  4.4.4.B  4.4.4.D  4.5.4.A  4.5.4.C | S4.B.3.3.1  S4.B.3.3.2  S4.B.3.3.3  S4.B.3.3.4  S4.B.3.3.5  S4.A.1.1.2  S4.A.1.3.5  S4.A.3.1.4 |
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| **5-6** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Biodiversity is the wide range of existing life forms that have adapted to the variety of conditions on Earth from terrestrial to marine ecosystems. | Use models to explain biodiversity in ecosystems. | Biodiversity  Adapt  Terrestrial  Marine | 3.1.8.C  3.4.8.E | S8.B.2.1.1  S8.B.2.1.2 |
| **5-6** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Changes in biodiversity can influence humans’ resources. | Use evidence to construct arguments for how biodiversity can influence the availability of humans' food, energy, and medicine. | Food  Energy  Medicine | 3.1.8.A  3.4.8.A  4.2.8.C | S8.B.3.2.2 |
| **5-6** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Anatomical similarities and differences between various organisms living today, and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference of lines of evolutionary descent. | Construct explanations for the anatomical similarities and differences between fossils of once living organisms and organisms living today. | Anatomical  Fossil Record  Evolutionary History  Evolutionary Descent | 3.1.8.C  3.4.8.E | S8.B.2.1.2  S8.B.2.1.5 |
| **7-8** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Fossils are mineral replacements, preserved remains, or traces of organisms that lived in the past. | Develop explanations for why most individual organisms, as well as some entire species of organisms, that lived in the past were never fossilized. | Mineral Replacement | 3.1.8.C  3.4.8.E | S8.B.2.1.2  S8.B.2.1.5 |
| **7-8** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | The collection of fossils and their placement in chronological order is known as the fossil record. | Analyze and interpret patterns of change in fossils to provide evidence of the history of life on Earth. | Chronological | 3.1.8.C  3.4.8.E | S8.B.2.1.5 |
| **7-8** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Comparison of the embryological development of different species also reveals similarities that show relationships not evident in the fully-formed anatomy. | Recognize and compare patterns in the embryological development across different species to identify relationships not evident in the fully formed anatomy. | Embryological  Relationship | 3.1.8.C  3.4.8.E | S8.B.2.1.2  S8.B.2.1.5 |
| **7-8** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | In artificial selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. | Communicate explanations of ways technologies enable humans to influence the inheritance of certain traits in plants and animals. | Technology  Selective Breeding | 3.1.8.A  3.1.8.C  3.4.8.B  3.4.8.E  4.4.8.A  4.5.8.A  4.5.8.C  4.5.8.D | S8.B.2.1.4  S8.A.1.2.1 |
| **7-8** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Natural selection leads to the predominance of certain traits in a population, and the suppression of others. | Communicate explanations for how genetic variations of traits in a population increase some individual's probability of surviving and reproducing. | Natural Selection  Predominance  Suppression | 3.1.8.C  3.4.8.E | S8.B.2.1.1 |
| **7-8** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Natural selection leads to the predominance of certain traits in a population, and the suppression of others. | Use models to explain how natural selection over many generations results in changes within species in response to environmental conditions that increase or decrease certain traits in a population. | Natural Selection  Environmental Conditions | 3.1.8.C  3.4.8.E | S8.B.2.1.5 |
| **7-8** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. | Obtain and evaluate information about how two populations of the same species in different environments have evolved to become separate species. | Evolve  Natural Selection | 3.1.8.C  3.4.8.E | S8.B.2.1.1  S8.B.2.1.2  S8.B.2.1.3 |
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| **9-12** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Genetic information, like the fossil record, also provides evidence of evolution. | Use evidence obtained from new technologies to compare similarity in DNA sequences, anatomical structures, and embryological appearance as evidence to support multiple lines of descent in evolution. | Evolution | 3.1.B.A9  3.1.B.C3  3.1.B.C1  3.1.B.B3 | BIO.B.3.2.1  BIO.B.3.3.1 |
| **9-12** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Natural selection occurs only if there is both a variation in the genetic information between organisms in a population and a variation in the expression of that genetic information (trait variation) that leads to differences in performance among individuals. | Plan and carry out investigations to gather evidence of patterns in the relationship between natural selection and changes in the environment. | Natural Selection  Genetic Information | 3.1.B.C1 | BIO.B.3.1.1 |
| **9-12** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. | Analyze and interpret data to explain the process by which organisms with an advantageous heritable trait tend to increase in numbers in future generations; but organisms that lack an advantageous heritable trait tend to decrease in numbers in future generations. | Advantageous  Heritable Trait | 3.1.B.C1 | BIO.B.3.1.1 |
| **9-12** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Natural selection is the result of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment’s limited supply of the resources that individuals need in order to survive and reproduce, and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. | Use models to explain how the process of natural selection is the result of four factors. | Natural Selection  Competition  Proliferation | 3.1.B.C1 | BIO.B.3.1.1 |
| **9-12** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Natural selection leads to adaptation, that is, to a population dominated by organisms that are anatomically, behaviorally, and physiologically well suited to survive and reproduce in a specific environment. | Use evidence to explain the process by which natural selection leads to adaptations that result in populations dominated by organisms that are anatomically, behaviorally, and physiologically able to survive and/or reproduce in a specific environment. | Physiologically  Adaptation  Anatomically  Behaviorally  Physiologically | 3.1.B.C1 | BIO.B.3.1.1 |
| **9-12** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. | Obtain and communicate information describing how changes in environmental conditions can affect the distribution of traits in a population and cause increases in the numbers of some species, the emergence of new species, and the extinction of other species. | Differential  Heritable Trait  Emergence  Extinction | 3.1.B.C1  3.1.B.C2 | BIO.B.3.1.2 |
| **9-12** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. | Use evidence to construct explanations and design solutions for the impact of human activities on the environment and ways to sustain biodiversity and maintain the planet’s natural capital. | Sustain  Natural Capital  Invasive Species  Climate Change | 4.1.10.A  4.1.10.B  4.1.12.A  4.1.4.A  4.1.12.C  4.1.4.E  4.1.7.E  4.1.10.E  4.5.10.D  4.2.8.A  4.2.10.A  4.2.12.A  4.2.10.B  4.2.12.B  4.2.10.C  4.2.12.C  4.3.12.A  4.3.10.B  4.5.10.B  4.5.12.B  4.5.4.C  4.5.7.C | BIO.B.4.2.4 |
| **9-12** | Biological evolution explains both the unity and diversity of species and provides a unifying principle for the history and diversity of life on Earth. | How can there be so many similarities among organisms yet so many different kinds of plants, animals, and microorganisms? How does biodiversity affect humans? | Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction). Biological extinction, being irreversible, is a critical factor in reducing the planet’s natural capital. | Design solutions for creating or maintaining the sustainability of local ecosystems. | Speciation  Extinction  Natural Capital | 4.1.4.A  4.1.10.A  4.1.12.A  4.1.7.E  4.1.10.E  4.1.4.E  4.2.10.C  4.5.3.D  4.5.5.D  4.5.6.D  4.5.10.D  4.2.10.A  4.2.7.A  4.2.8.A  4.2.10.B  4.4.6.A  4.4.6.B  4.4.3.C  4.4.5.C  4.5.7.B  4.5.7.C | BIO.B.4.2.5 |
| **9-12** | (NOT ADDRESSED BY THE LIFE SCIENCE CURRICULUM FRAMEWORK: PROPERTIES OF WATER (E.G. FREEZING POINT, HIGH SPECIFIC HEAT, COHESION). See Physical Science. | | | | | | BIO.A.2.1.1 |